To: Dr. Jerry Meral, CA Resources Agency
From: Jon Rosenfield, The Bay Institute
Date: December 22, 2011
Re: Review of BDCP Effects Analysis Appendix G

These comments represent our preliminary, abbreviated review of this document and do not purport to be a thorough and comprehensive critique. Given our ongoing concerns regarding the adequacy of the current analytical framework for the Plan, we hope these comments will be useful in revising the Effects Analysis to construct a more sound foundation.

As we have commented before, the Effects Analysis should address questions of particular interest to decision-makers; answers to these questions flow from implementation of the Logic Chain planning framework. Instead, Appendix G illustrates the Effects Analysis' haphazard, piecemeal, and selective approach to evaluating project impacts. As with previous BDCP Effects Analysis (EA) Appendices, the current document reflects an obsession with particular tools rather than a focus on addressing the questions that must be answered to provide a fair assessment of the magnitude and certainty of plan impacts. As before, the tools identified here were not selected with reference to the BDCP Logic Chain, the program's (still undeveloped) goals and objectives, or DRERIP conceptual models (which already answer the questions implicitly asked within this Appendix). Worse, the tools selected are inadequate to the task and appear to have been selected in order to support a pre-determined outcome. Finally, the implications of the results generated by these models are portrayed in a biased way intended to support a particular worldview – no reference is made to the large body of evidence that contradicts this worldview.

<u>Analytical tools should be chosen/designed to answer relevant questions that emerge from a logical progression from BDCP Goals and Objectives, through stressor identification and estimation of the level of stressor reduction needed to attain the goals and objectives, to conservation measures designed to achieve specific stressor reduction targets.</u>
The Appendix opens with the statement: *This appendix describes the application of four models to help determine population-level effects of the Bay Delta Conservation Plan (BDCP) covered activities on selected covered fish species.* These four models are brought to bear on analysis of just three of BDCP's covered species: Delta smelt, winter run Chinook salmon, and spring run Chinook salmon. The EA does not address why there is an appendix dedicated to assessing impacts solely to these three covered species using a very limited (and controversial) set of models. The reason for this unexplained and unacceptable focus appears to be because these three species can be analyzed with the models the authors wanted to employ. As happens repeatedly throughout the EA, the methods determine the questions that get asked/analyzed, instead of tools being chosen specifically because they are capable of answering questions that are actually important.

Apparently, the EA intends to rely on the models in Appendix G to identify and rank stressors that BDCP will address. Identification and ranking of stressors is an important task in planning actions that will restore the covered species and the estuarine ecosystem. According to the Logic Chain framework, this effort follows from identification of BDCP Goals and Objectives;

defining what the Plan seeks to accomplish (which stressors will be reduced and by how much) would help focus the plan what ecosystem stressors are most important to address. As we have noted, BDCP's biological goals and specific objectives still remain to be developed; thus, the identification and ranking of stressors is premature because one cannot precisely identify the barriers to project success until one defines what success means (i.e. S.M.A.R.T. Objectives).

The exercise of stressor identification and efforts to rank stressors properly belongs in the Conservation Strategy (Chapter 3). The Effects Analysis should evaluate the efficacy and uncertainty of a particular conservation strategy that has already determined Plan goals and objectives and the means (stressors, stressor reduction targets, conservation measures) to achieve those objectives. The fact that Appendix G to the EA attempts to identify which stressors the Plan should address strongly suggests that the Conservation Strategy was assembled to address a collection of stressors whose importance and likelihood had not been specifically evaluated prior to designing the plan. That this appendix appears to justify the stressors that the Conservation Strategy happened to address is convenient, but not convincing.

<u>Quantitative models are not the best and certainly not the only tools for identifying and ranking stressors that will be the focus of BDCP restoration efforts</u>

The life cycle models described in Appendix G are not the only or even a good way to identify and rank stressors that the Plan will address. As elsewhere, Appendix G mistakes the appearance of rigor generated by quantitative tools with accuracy or relevance of those tools. The models themselves are untested and in some cases have been the subject of extensive criticism; at best, they represent only one hypothetical listing and ranking of key stressors. The fact that the models are quantitative does not make their outputs more valuable than the rankings produced by qualitative models or the best professional judgment of the community of experts with actual experience in this ecosystem. Indeed, the Delta Stewardship Council's independent science panel, which recently reviewed available salmon life history models, observed:

> *Developing a life cycle model involves judgment by the developers as to what to include in the model (and what to leave out), how best to simplify the processes (growth, mortality, reproduction, movement) to be included, and the time and space scales to explicitly represent. There is pressure to include complexity because everyone knows of details about the system that are important. Countering this pressure for complexity is the push back from the limitations imposed by the lack of available data and the general principle of parsimony. Data are needed to estimate model parameters and inputs, and to check model performance. ... It is important to note that all modeling relies on a degree of judgment. People sometimes get the impression that life cycle population modeling is extreme in the need for judgment, with the model almost appearing arbitrary in its development. For example, hydrodynamics modeling appears to people as well-known and hydrodynamics model development as more rigorous. This perception arises from hydrodynamics modeling relying on known physical principles (conservation of mass and continuity of momentum). However, there is a large element of judgment and "art" to hydrodynamics modeling as well: resolution of the grid, type of grid, solution method, and turbulence closure terms.*

Thus, while life cycle modeling has a less rigorous foundation from which to build than hydrodynamics, all modeling involves judgment [Rose et al. 2011, p. 6[1]]

This independent review panel also warned about the dangers of using life cycle models linked to hydrodynamic models because of the potential to propogate uncertainty and because the life cycle models have not been and cannot be validated beyond the range of hydrodynamic values under which their foundational inputs were developed. By contrast, the Appendix claims:

> *Life cycle models are an important tool in the preliminary proposal effects analysis because they integrate predicted effects of conservation actions on the population dynamics of a species through linkages among life stages over a wide range of potential future conservation actions, within the context of a wide range of potential future hydrologic and environmental conditions.*

Then the Appendix then immediately backs away from the presumed values of the life cycle models, that it just asserted, stating:

> *The four life cycle models used in this analysis have not been used to predict changes in abundance of the target covered fish species. This is because of the uncertainty in various relationships inherent in population life cycle modeling, the propagation of errors and uncertainty within the models, and because the available models do not capture all aspects of the BDCP including those assumed to be beneficial at population levels (i.e., restoration). Rather, the model results are considered to be more robust and appropriate for relative comparisons in the response of a population to conditions anticipated to occur under two or more potential future conditions. The preliminary proposal effects analysis uses life cycle models to provide relative comparisons among the effects of alternatives…"*

Appendix G concedes that the models selected have a limited scope to identify stressors; because they are quantitative models, their outputs (stressor rankings, in this case) depend entirely on the availability and quality of data available as inputs. The Executive Summary reveals the limited application for the life cycle models it employs:

> *Because of how these models are constructed, each of these models is only able to capture some of the effects of the preliminary proposal. Therefore, the results of each model provide an incomplete prediction of population-level effects of the preliminary proposal on these species. The models are fundamentally constrained in that they are based on species–habitat relationships that have been established for the existing configuration of the San Francisco Bay/Sacramento–San Joaquin River Delta (Bay-Delta) and therefore do not incorporate the substantial changes in the landscape proposed to occur with proposed habitat restoration.*

But, the Appendix does not address the effect of these limitations on the selection of stressors on which BDCP will focus. Rather, it uses model outputs as validation of BDCP's decision to focus nearly exclusively on habitat restoration as a fix for all that ails the Delta ecosystem and its imperiled species.

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[1] Rose, K. A., J. Anderson, M. McClure, and G. Ruggerone. 2011.Salmonid Integrated Life Cycle Models Workshop. Workshop organized by the Delta Science Program. June 14, 2011

The BDCP must incorporate the numerous, well-documented lists of stressors and rankings of their relative importance that have been produced by pre-eminent experts in the fields of restoration planning, ecology, ecosystem science, and the local species and habitats of interest. The exercise of identifying and ranking stressors important in this ecosystem and for these covered species has been performed numerous times before, including specifically for BDCP. The Appendix completely ignores the wealth of expert studies and peer-reviewed professional assessment of the stressors operating in this system and their relative importance to ecosystem and covered species recovery. A non-exhaustive list of such efforts follows:

- DRERIP conceptual life history and ecosystem process models (which are supposed to be the foundation of the BDCP's EA) explicitly identify and rank the stressors which effect each life stage. These models also identify the uncertainty and scientific understanding associated with the stressors so that decision makers can evaluate the risk associated with addressing different stressors;
- the 2009 DRERIP evaluation of BDCP's conservation strategy implicitly ranked stressors in determining the likely impact of proposed actions on the stressors assumed to affect covered species;
- testimony to the SWRCB during the recent public trust flows hearings and the final recommendations of the Board provided a great deal of direct testimony on the relative importance of different stressors operating in this ecosystem;
- the Delta Stewardship Council's science panel was tasked with identifying and ranking stressors;
- recovery plans associated with the covered species (e.g. the NMFS draft recovery plan for central valley salmonids) rank stressors for certain covered species.

Furthermore, numerous independent scientific reviews of the Biological Opinions have opined about the likely relative benefits to listed species of addressing different stressors in the Delta.

To our knowledge, the EA does not acknowledge of any of these processes or their findings regarding the relative importance of key stressors. Each of these processes engaged the foremost experts in a variety of fields relevant to ecosystem recovery in the Delta. But the EA appears to rely completely on a select and narrow set of untested models, which in some cases were developed by modelers with little or no expertise in this ecosystem or its at-risk species.

It is not clear why Appendix G employs the models it does.
These models have been thoroughly reviewed and found to be lacking in several regards – even as tools for identifying key stressors in the Delta[2]. For example, the Delta Science Council's review of the IOS, OBAN, and other salmonid life history models concluded, "*…none of the existing models were sufficiently well suited to examining the water management and RPA questions to justify their selection as the model to use.*" [p. 18]

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[2] We will not here reiterate critiques of these models here (though we will provide specific critiques if requested by the Consultants or resource agencies), because a lengthy discussion of the models' veracity and relevance would detract from the serious concerns we have regarding their utility, application, and interpretation (even if they were suited to the purposes intended by the EA). We do note however, that our previous critiques of DPM (provided as part of comments on Appendix C) are applicable to the IOS model, which relies on the former model as an input.

The Appendix seriously misrepresents the results of the models it applies.
As we have commented earlier (re: EA Appendices A, B, and C), the ecological purpose of BDCP is to generate a contribution to recovery of all covered species. Appendix G makes the same mistake as those earlier appendices in comparing outcomes only to modeled, hypothetical "baselines". As a result, the Appendix mischaracterizes the finding that modeled outcomes from OBAN and IOS regarding the impacts of BDCP on winter run are "different". The two models generate *quantitatively* different predictions – OBAN projects reduced escapement for winter-run under BDCP whereas IOS does not detect a difference between BDCP and the hypothetical baseline. However, these results are not different in the context of BDCP's legal requirements because neither finds that there will be *a net improvement* in winter run Chinook salmon conservation status.

Furthermore, to the extent that both life-cycle models project: *"... that climate change will adversely affect the winter-run Chinook salmon population in the future through changes in hydrologic conditions and increased exposure to elevated water temperatures*," the Appendix documents an increased negative impact of the Projects to winter-run Chinook salmon in the future. Because these "climate change impacts" arise as a result of the existence and operation of the Projects, it is inappropriate to dismiss them simply because they appear in each of the scenarios modeled here– the Projects are still responsible for mitigating the negative impacts and contributing to the recovery of the species.

The Appendix's interpretation of the Maunder and DEriso model is incorrect; this model did indeed find a strong effect of adult entrainment on Delta smelt populations. The authors exercised their judgment that this effect was "unreasonably large" and thus discounted the impact of entrainment. In addition, although we have severe reservations about the construction, utility, application, and interpretation of the so-called "State-Space Multistage Delta Smelt Life Cycle" developed by Maunder and Deriso[3], we note that the Appendix's summary of this model's outputs ("*covariates most likely to have population-level effects were not affected by the BDCP*") is a round-about way of saying that the proposed project is not expected to benefit Delta smelt. If the authors believe that the models employed in this Appendix are capable of identifying which variables are most important to covered species (a questionable claim since many important variables were not input into the model), then the executive summary's presentation of conclusions should be transparent regarding the implications of the models' findings. Namely, if the authors truly believe the model results, that factors affected by BDCP

[3] Including, but not limited to, (a) many of the inputs into the model are ecologically irrelevant or improperly expressed for modeling purposes; (b) model inputs were selected by a statistician with no expertise in fish biology in a non-peer reviewed, non-public manuscript; (c) no flow variables were input into the model (so it is not surprising that they were not found to be important predictors of Delta smelt population response), and (d) Maunder and Deriso actually did find a significant impact of Adult Entrainment on Delta smelt populations but they inexplicably dismissed the finding and failed to explore and correct the cause of the "unrealistically large" effect of this entrainment parameter.

are not highly relevant to the viability of certain covered species[4], then the results call for a rethinking of the project itself so that new conservation measures can be developed that serve the goal of contributing to species recovery. To claim, as the Appendix does that, "*the delta smelt life cycle model results, are consistent with the purpose of many of the proposed conservation measures*" avoids the fact that these model results are *not* consistent with the purpose of other conservation measures that are central to the BDCP's conservation strategy (e.g. a new North Delta diversion). The Appendix ignores the implication that the model results suggest that the impact of Project operations proposed in BDCP (e.g. reduced Delta outflow) would counteract what Appendix G identifies as the key stressor that BDCP will address--food supplies would be expected to decline in response to reduced Delta outflow (Jassby et al. 1995, Kimmerer 2002; Kimmerer et al. 2009).

The Appendix's finding that flows and entrainment are not important stressors to the species studied (much less, to restoration of the Delta as a whole) is without basis and ignores the wealth of expert opinion to the contrary.

Each of the processes that have previously described and ranked stressors in this ecosystem (briefly and incompletely described above) identified the magnitude, timing, and variability of fresh water flow and entrainment and indirect mortality as a result of south Delta water exports as among the most important variables in determining the success or failure of conservation and recovery efforts. The models used in Appendix G minimize the impact of these two variables, though they are clearly the two variables most under control of the state and federal Projects. The EA's failure to acknowledge, incorporate, and (where appropriate) respond to these previous efforts illustrates how haphazard and incomplete its analyses are. For example:

- a panel of experts convened by the SWRCB for its flow hearings (SWRCB 2010[5]) found "*[F]low modification is one of the few immediate actions available to improve conditions to benefit native species*";
- the State Board (2010) itself specifically addressed the BDCP stating: "*...this [Public Trust Flow] report highlight[s] the need for the BDCP to develop an integrated set of solutions, to address ecosystem flow needs, including flow and non-flow measures. ... One cannot substitute for the other; both flow improvements and habitat restoration are essential to protecting public trust resources*";
- the DRERIP conceptual life-history models[6] for Delta smelt, longfin smelt, and salmonids (for instance) each clearly identify water exports and fresh water flow (or the position of X2) as important drivers of population response;
- the Draft Recovery Plan for Central Valley salmonids (NMFS 2009)[7] repeatedly emphasizes the need to improve fresh water flow conditions in the Delta and to reduce entrainment at water exports;

[4] We wish to emphasize that the Maunder and Deriso model did not evaluate the effect of any freshwater flow variable that might be affected by BDCP, so it the interpretation that BDCP's affect on flow is not relevant to Delta smelt recovery is highly inaccurate and misleading.

[5] State Water Resources Control Board Development of Flow Criteria for the Sacramento-San Joaquin River Ecosystem, 2010, p. 1. Available at: http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/final_rpt080310.pdf

[6] Available at: http://www.dfg.ca.gov/ERP/conceptual_models.asp

[7] National Marine Fisheries Service. 2009. Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-

- the Delta Science Council's Independent Science Board (DSC 2011[8]) found that both "*Changed hydrograph; reduced inflow and outflow*" and "*Entrainment at pumps & other diversions*" were key stressors in the Delta (the former was listed in three different stressor categories);
- the BDCP EA itself, in Appendix A, states:
  Flow is a "master variable" ... in aquatic systems in the sense that it is responsible for creation and maintenance of many habitat features affecting biological potential. Characteristics of flow include magnitude, frequency, duration, timing, and rate of change that result in the natural dynamics of the system that structures biodiversity and ecological function of riverine (Stanford et al. 1996) and estuarine (Peterson 2003) systems. ... [p. A-28].

Given the focus on fresh water flow and export diversions as major drivers of ecosystem decline in the larger scientific community, the Appendix's dismissal of impacts related to these two variables is inexplicable.

<u>The Appendix repeats the pattern of asserting facts that are not in evidence or even analyzed in the Appendix at hand.</u>

For example, where are the assumptions represented in this statement evaluated?

> *Expansion of floodplain, tidal wetland, and channel margin habitat under BDCP is expected to result in an increase in organic matter production and an increase in zooplankton, the food resource for delta smelt, both in the restored habitat and potentially on a regional scale in the Delta. Increasing food supplies through aquatic habitat expansion in those areas of the estuary that are used by delta smelt (e.g., Cache Slough, Suisun Marsh, western Delta) therefore would be expected to contribute directly to an increase in delta smelt growth, survival, and population abundance as predicted by the life cycle model.*

It is not at all clear that expansion of these habitats at the scale anticipated under BDCP will produce a measureable increase in the food accessible to Delta smelt – both the NRC panel[9] and the preliminary DRERIP review conducted by BDCP in 2009 evaluated tidal marsh restoration actions similar to those described here and questioned the potential efficacy of these habitat restoration mechanisms on Delta smelt populations. For example, the NRC report concluded:

> *"...the relationship between tidal habitat and food availability for smelt is poorly understood, and it is inadequate to support the details of the implementation of [the BO's wetland habitat restoration action]... The committee recommends that [the tidal habitat restoration provisions of the Delta Smelt BO] be implemented in phases, with the first phase to include the development of an implementation and*

Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead. National Oceanic and Atmospheric Administration, NMFS Southwest Regional Office. Available at: http://www.nmfs.noaa.gov/pr/recovery/plans.htm

[8] Delta Science Council Independent Science Board. January 26, 2011 memo to Phil Isenberg, Re: "*Addressing Multiple Stressors and Multiple Goals in the Delta Plan*"

[9] National Research Council. 2010. *A Scientific Assessment of Alternatives for Reducing Water Management Effects on Threatened and Endangered Fishes in California's Bay Delta*. Committee on Sustainable Water and Environmental Management in the California Bay-Delta. 104 pp. http://www.nap.edu/catalog/12881.html

adaptive management plan (similar to the approach used for the floodplain habitat action in the NMFS biological opinion), but also to explicitly consider the sustainability of the resulting habitats, especially those dependent on emergent vegetation, in the face of expected sea-level rise. In addition, there should be consideration of the types and amounts of tidal habitats necessary to produce the expected outcomes and how they can be achieved and sustained in the long term. More justification for the extent of the restoration is needed.

Rather than incorporate and respond to the findings of well-regarded, expert panels (some convened by BDCP itself), the EA merely asserts as fact the same untested assumptions about the relationship between tidal habitats and food production and between food production and Delta smelt abundance. Furthermore, it is not clear why the quote above is found in an appendix about models that are explicitly not able to evaluate its veracity. This statement is an assertion without supporting evidence to be found in the materials we have seen so far and certainly not in the Appendix in which it occurs.

<u>The Appendix (and the EA as whole) ignore all attributes of viability beyond population abundance despite the facts that (a) the Conservation Strategy asserts that BDCP will contribute to recovery beyond simple increases in abundance and (b) the covered species' populations cannot be considered "recovered" (and delisted) until they demonstrate sustained improvement in all attributes of viability.</u>

The tools chosen for application in Appendix G reflect the EA's myopic focus on population abundance metrics. We have stressed consistently that abundance (population size) is only one attribute of population viability. Most of the covered species cannot be recovered simply by increasing their abundance; these populations will only be delisted when their geographic range (number of discrete places where they can complete critical life stages) is sufficient to immunize them from local catastrophic events and when their life history diversity (number of different successful growth and migration timings) is restored to an extent that the population is insulated from temporal variation in ecosystem properties (e.g. temperatures, food availability and type, predator densities, etc). The BDCP claims in various places that its actions will improve the spatial distribution of covered species (e.g. by creating new spawning habitats and migration corridors) and contribute to restoration of natural patterns of life history diversity, but, throughout the EA, there is no actual analysis of these claims. Appendix G should focus on identifying stressors particular to restoration of these life history attributes in the same way that it (half heartedly) attempts to characterize stressors that drive population response.

It is important to note that the stressors and ranking of stressors that impede population growth are not necessarily the same as those that prevent covered species from spawning in all the places where, and during all the seasons/months when they spawned historically. The Delta Stewardship Council observed: *"... a stressor should be defined in terms of its effect on a key system attribute and an objective for that attribute*." Thus, stressors that impede life history variation or constrict covered species' geographic range should be defined separately from those identified as limiting population abundance; even though the force being described may be the same, the way it acts as a stressor likely differs depending on the attribute of viability in question. The models employed in Appendix G are not capable of identifying stressors that affect attributes of viability other than population abundance (much less ranking them). In their review of available life cycle models for salmonids in the Central Valley, including those applied in Appendix G, Rose et al (2011) cautioned:

> *Consideration of life history variation and spatial distribution, in addition to usual focus on population abundance, is needed in order to address the VSP criteria. Life cycle models are single-species and often focused on abundance, with life history variation and spatial dynamics of secondary consideration. A new model developed by NMFS for its Section 7 consultations] should be developed with the long-term goal of eventually including the effects of life history variation and spatial distribution. Use of different spawning areas, the timing of the upstream migration of spawners and downstream migration of smolts, the areas used for rearing (fry to smolt transition), and the role of jacks are all potentially important issues related to life history diversity and spatial distributions.*